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Incorporating corrigendum July 2016

BSI Standards Publication

Tanks for the transport of dangerous goods — Transport tank equipment for overfill prevention devices for static tanks

bsi.

National foreword

This British Standard is the UK implementation of EN 16657:2016. Together with BS EN 13616-1:2016 and BS EN 13616-2:2016 it supersedes BS EN 13616:2004 which is withdrawn

The UK participation in its preparation was entrusted to Technical Committee AUE/18, Tanks for the transport of dangerous goods.

A list of organizations represented on this committee can be obtained on request to its secretary.

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Amendments/corrigenda issued since publication

Date	Text affected
31 July 2016	Correction to supersession details in national foreword

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 16657

June 2016

ICS 13.300; 23.020.20

Supersedes EN 13616:2004

English Version

Tanks for the transport of dangerous goods - Transport tank equipment for overfill prevention devices for static tanks

Citernes destinées au transport de matières dangereuses - Dispositifs limiteurs de remplissage pour réservoirs statiques à bord de véhicules-citernes

Tanks für die Beförderung gefährlicher Güter - Transporttankausrüstung für Überfüllsicherungen für ortsfeste Tanks

This European Standard was approved by CEN on 6 June 2015.

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European foreword

This document (EN 16657:2016) has been prepared by Technical Committee CEN/TC 296 “Tanks for the transport of dangerous goods”, the secretariat of which is held by AFNOR.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by December 2016 and conflicting national standards shall be withdrawn at the latest by 2017-07-11.

This document, together with EN 13616-1 and EN 13616-2, supersedes EN 13616:2004.

With reference to EN 13616:2004, the following significant changes have been made:

— splitting of EN 13616:2004; the new EN 13616, under the general title *Overfill prevention devices for static tanks for liquid fuels — Requirements and test/assessment methods*, will consist of the following parts:

  — *Part 1: Overfill prevention devices with closure device;*

  — *Part 2: Overfill prevention devices without closure device.*

— reference to EN 14116;

— explosion-technical parameters updated;

— the requirements for the equipment of the overfill prevention devices without closure device on the static tank are fixed in EN 13616-2;

— the requirements for the equipment of the overfill prevention devices without closure device on the tank vehicle are fixed in EN 16657.

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1 Scope

This European Standard specifies the minimum performance and construction requirements for overfill prevention controllers located on the tank vehicle.

This European Standard applies to overfill prevention controllers for liquid fuels, having a flash point up to but not exceeding 100 °C.

The requirements apply to overfill prevention controllers suitable for use at ambient temperatures in the range from -25 °C to +60 °C, and subject to normal operational pressure variations.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 13616-2:2016, *Overfill prevention devices for static tanks for liquid fuels — Part 2: Overfill prevention devices without a closure device*

EN 14116, *Tanks for transport of dangerous goods — Digital interface for the product recognition devices for liquid fuels*

EN 60079-0, *Explosive atmospheres — Part 0: Equipment — General requirements (IEC 60079-0, modified)*

EN 60079-11, *Explosive atmospheres — Part 11: Equipment protection by intrinsic safety "i" (IEC 60079-11)*

EN 61000-6-1, *Electromagnetic compatibility (EMC) — Part 6-1: Generic standards — Immunity for residential, commercial and light-industrial environments (IEC 61000-6-1)*

EN 61000-6-3, *Electromagnetic compatibility (EMC) — Part 6-3: Generic standards — Emission standard for residential, commercial and light-industrial environments (IEC 61000-6-3)*

EN ISO 13849-1, *Safety of machinery — Safety-related parts of control systems — Part 1: General principles for design (ISO 13849-1)*

ISO 7637-2, *Road vehicles — Electrical disturbances from conduction and coupling — Part 2: Electrical transient conduction along supply lines only*

3 Terms, definitions and abbreviated terms

For the purposes of this document, the terms, definitions and abbreviated terms given in EN 13616-2 and the following apply.

3.1 Terms and definitions

3.1.1
overfill prevention controller
controller
installed on the tank vehicle, connects to sensors mounted in or on the tank, and provides an output

3.2 Abbreviated terms

PRD Product Recognition Device

4 Requirements

4.1 Effectiveness

The filling process shall not start or shall automatically stop in the event of failure of the power supply.

Detection of a sensor´s signal "non-permissive" shall result in a shut-down of the product flow by the controller.

Stopping the product flow shall not generate pressure in excess of the designed criteria for the whole system.

4.2 Construction

The design shall be compatible with the ambient temperature range of -25 °C to +60 °C. The manufacturer shall confirm the compatibility of materials, which may be in contact with the liquid and/or its vapour phase.

If the controller forms part of an earth continuity path, then the conductivity of the path shall be $< 10^6\ \Omega$.

The controller shall be of a durable construction.

The selection of materials and manufacturing processes shall consider environmental aspects.

5 Overfill prevention device

5.1 Equipment on the tank

A sensor with mechanical interface shall be according to EN 13616-2.

5.2 Equipment on the tank vehicle

The following equipment shall be on the tank-vehicle:

— one or more controllers;

  The controller shall provide:

  — interface up to the maximum specified number of sensors;

  — permissive/non-permissive output states.

— product supply system;

— appropriate devices for stopping the product flow;

— a connection between the controller and the sensor fitted with a socket according to Figure 1.

5.3 EMC requirements

The controller shall comply with:

— EN 61000-6-3 for emission;

— EN 61000-6-1 for immunity.

Furthermore, the controller shall be suitable for safe operation at the power supply of the tank vehicle. Disturbances according to ISO 7637-2 (pulse 2a, 2b, 3a, 3b and 4) shall not lead to malfunction.

5.4 Working characteristics

5.4.1 General

Upon the detection of a sensor´s signal "non-permissive", the controller shall provide a signal which causes the appropriate devices to stop the product flow, to prevent an overfill. A device shall be provided to indicate that the maximum filling level has been reached.

The overfill prevention device shall include an interface to ensure the safe working function and self-checking.

Power supply interruption or short circuit may be indicated.

5.4.2 Response time

— Sensor detection of the liquid to controller output as summary of two reaction times from status permissive to status non-permissive: maximum 2,5 s;

  — reaction time of the sensor (Δt_R) from status permissive to status non-permissive: maximum 1,5 s according to EN 13616-2;

  — controller reaction time from permissive to non-permissive: maximum 1 s;

— controller output to the ceasing of product flow: maximum 3 s.

The maximum time from the detection of the liquid to the ceasing of product flow shall be 5,5 s.

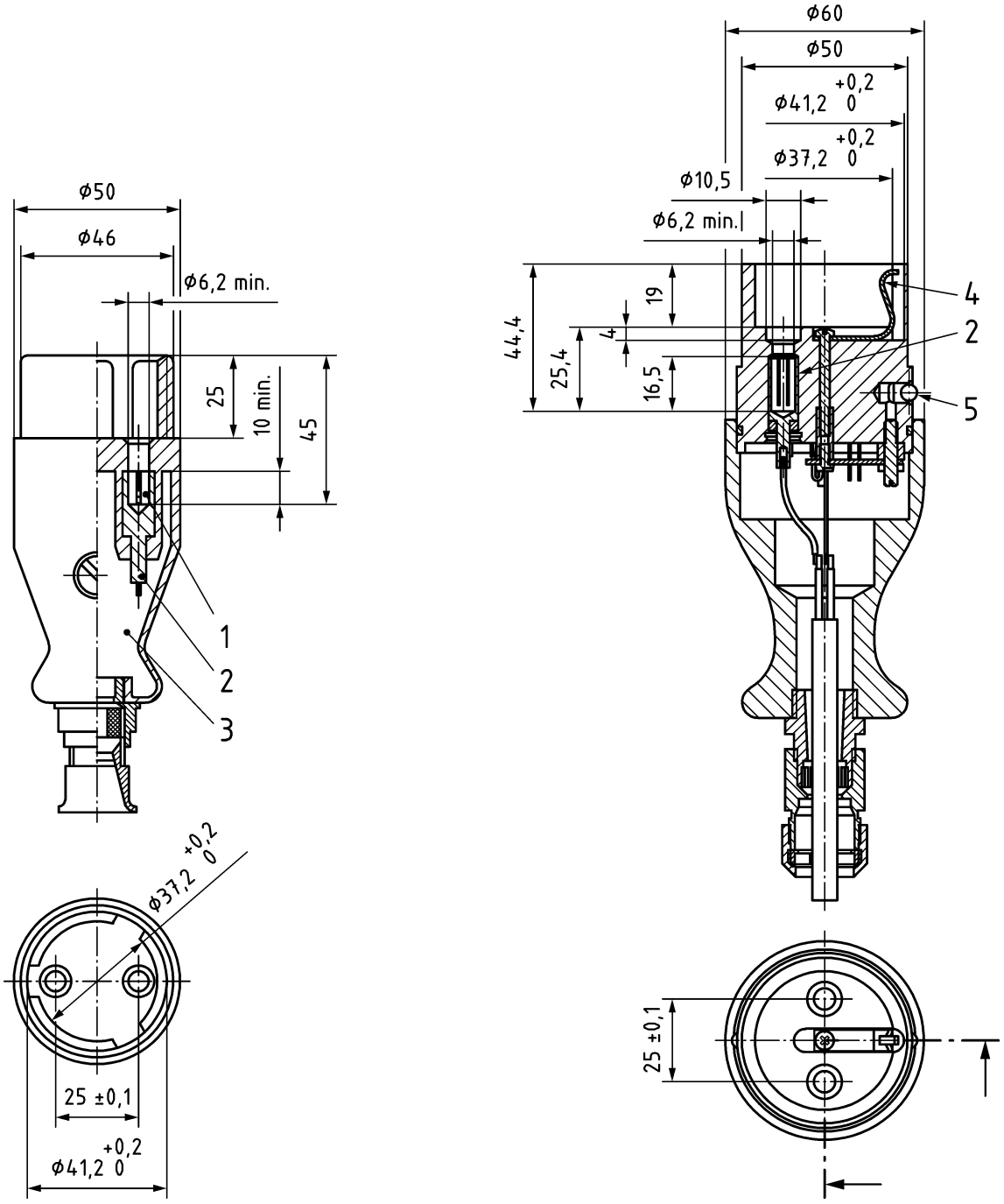
5.4.3 Current interface

5.4.3.1 Socket

The socket of the plug/socket connection between the controller and the sensor shall be according to Figure 1.

Both socket types can be connected to plug type 907, type AS 907, type 904 or type 905 according to EN 13616-2. However, the types AS of sockets and plugs provide listener and grounding connection.

Dimensions in millimetres



a) Socket type 903 **b) Socket type AS 903**

Key

1 contact tractive power of the spring sleeve min. 2,5 N
2 thermistor contact 2x: material: brass nickel plated
3 cable strain relief
4 listener contact
5 electrical contact 2 x

Figure 1 — Mechanical construction of the controller socket

5.4.3.2 Cable

The cable connecting the socket to the controller shall be of a flexible type. The loop resistance of the cable and socket shall be < 6 Ω.

5.4.3.3 Current interface electrical

The voltage of the measuring circuit has to be stabilized over the whole temperature range to a value of (19,0 ± 0,3) V. The voltage value of (19,0 ± 0,3) V shall also be held up for a load up to a current of 80 mA. The internal resistance of the supply circuit shall be (160,0 ± 3,2) Ω.

The safety-related Ex parameters of the controller to power the sensor shall be at least Ex ia IIB T3 according to EN 60079-0 and EN 60079-11. The safety-related Ex values shall not exceed:

— output voltage U_0 = 25 V

— output current I_0 = 165 mA

— output power P_0 = 1 W

5.4.4 Operating conditions

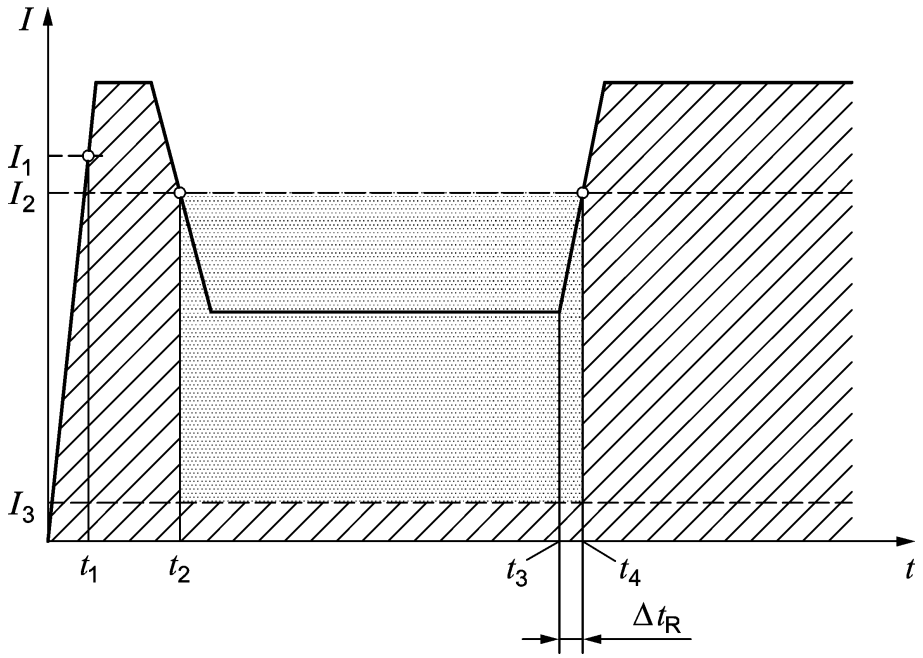
Live connection or disconnection of the sensor shall not affect the function of the controller.

At the beginning of each operation the overfill prevention device shall perform a test of the sensor and controller automatically.

A failure of subassembly of the overfill prevention device, and interruption or short circuit of the signal path and/or the power supply shall prevent or stop the product flow.

Product flow shall be permitted when the signal is above I_3 and below I_2 following warm up according to Figure 2 and Table 1. Product flow shall not be permitted in all other conditions.

If the output of the controller is an electrical signal, it shall not erroneously generate a permissive signal when connected in reverse polarity.



Key

range for signal "filling permitted"

range for signal "filling not permitted"

t_1 time of recognition of start of sensor warm up ($I > I_1$)

t_2 time of recognition of reaching sensor operating condition

$0{,}5\ s < (t_2 - t_1) < 180\ s$

NOTE If $(t_2 - t_1) > 180$ s no product flow is possible.

t_3 time of wetting sensor

t_4 time of recognition of a wet sensor, i.e. stop of product flow shall be initiated

Δt_R $\Delta t_R = t_4 - t_3$

Reaction time of the sensor (Δt_R) from status permissive to status non-permissive shall be ≤ 1,5 s.

Figure 2 — Cycle of current interface

Table 1 — Current values at interface

Current	Max. value mA	Min. value mA	Remark
I_1	49,5	41	$I_1 > I_2$
I_2	44	38	
I_3	10	2	—

5.4.5 Current interface – Auxiliary contact

When crossover prevention devices with PID according to EN 14116 are installed in parallel with overfill prevention sensors, an optional circuitry of the controller or of the PRD may evaluate the conductivity between the hose and an additional contact in the plug/socket connection ("listener contact") and thus shall ensure that only the sensor assigned to the appropriate ground tank can be used to generate the permissive signal.

The wiring between the PID and the listener contact shall be according to EN 13616-2.

The method used to detect the listener interconnection shall not interfere with the explosion protection characteristics of the PID circuitry. Measurement of the voltage at the listener input(s) by the PRD during the interrogation period of the appropriate PID is recommended.

5.4.6 Binary/Digital Interface

If binary/digital interface is provided, it shall be according to EN 14116 and EN 13616-2:2016, Figure 4 b).

Fail-safe properties of sensor, PID and PRD shall be in accordance with EN ISO 13849-1 performance level (PL) b.

The overfill prevention system shall be divided into three sub-devices:

— Overfill sensor

  The overfill sensor provides its signal to the PID.

  NOTE The specification of the overfill sensor and the interface between PID and overfill sensor are not part of this document.

  The interface shall be self-checking and fail-safe.

— Digital interface (PID)

  The PID analyses the sensor signal and provides the result to the PRD, using the PID protocol given in EN 14116.

  In all cases of wrong connections between PID and sensor (short circuit / disconnection) or an invalid sensor signal the PID shall report "Overfill sensor defect".

  The reaction time from wetting the sensor to transmitting the telegram according to EN 14116 from PID to PRD shall be ≤ 1,5 s.

— PRD

  The PRD can be any electronic device that is able to power the PID and read the messages sent by the PID. The PRD shall analyse the PID protocol and evaluate the state of the sensor.

  To test the PRD a digital signal source (PID-simulator) and a simulator for the connections (hose simulator) are required as described in EN 14116. The PRD shall be self-checking and fail-safe.

  The reaction time from receiving the digital signal change (from permissive to non-permissive) to the output of the controller shall be ≤ 1 s.

6 Test

6.1 Type test

6.1.1 General

The tests shall be carried out on a sample of one controller.

The results shall be recorded.

6.1.2 Performance tests – controller

Tests shall be performed at the following temperatures without a failure:

— number of cycles at temperature of (+20 ± 5) °C = 10;

— number of cycles at temperature of (-25 - 5) °C = 10;

— number of cycles at temperature of (+60 +5) °C = 10.

Each of these tests shall be carried out at minimum, maximum and nominal supply voltage as specified by the manufacturer.

To test the controller a sensor simulator shall be used.

The sensor simulator shall consist of a passive current source which shall sink a stabilized current at a varying supply voltage between DC 5 V and DC 20 V and able to withstand a short circuit current of ≥ 114 mA. The current shall be selectable between 0 mA and 60 mA.

1) Connect the controller to the sensor simulator.

2) Power up the system, set sensor simulator at 0 mA.

3) The controller output shall remain stable in the non-permissive state.

4) Setting the sensor simulator to a current value between $I > I_3$ and $I < I_2$ for any duration shall result in a non-permissive signal of the controller.

5) Switch sensor simulator to $I > I_1$ for > 0,5 s.

6) Reducing the current to $I < I_2$ but with $I > I_3$ shall lead to a permissive signal.

7) Setting the current to $I > I_2$ shall result in a non-permissive signal, the time shall be recorded and shall not exceed 1,0 s.

8) Repeat step 2) to 6). Reducing the current $I < I_3$, record the time until non permissive signal is obtained, which shall not exceed 1,0 s.

9) Repeat step 2) to 6). Reducing the current to 0 mA, switch to $I > I_1$ and reduce the current to $I < I_2$ within < 0,5 s, this shall result in a non-permissive signal.

10) Repeat step 2) to 6). Disconnect the sensor simulator (open circuit condition), the output of the controller shall result in a non-permissive signal.

11) Repeat step 2) to 6). Short circuit the current interface, the output of the controller shall result in a non-permissive signal.

12) Reducing the current to 0 mA, switch to $I > I_1$ and reduce the current to $I < I_2$; after > 180 s, this shall result in a non-permissive signal.

For the binary/digital interface the test procedure according to 6.3 shall be used.

6.1.3 Fail-safe test

6.1.3.1 General

Fail-safe requirements are fulfilled for controllers with current interface if the automatic starting-check of each filling cycle (heat up) is carried out successfully.

For the binary/digital interface the electronic circuitry of the controller and the sensor shall be designed and tested according to the rules for PL b of EN ISO 13849-1.

6.1.3.2 Tests common for both types, current interface and binary/digital interface

The following tests shall be carried out 10 times at (-25 - 5) °C, (+20 ± 5) °C and (+60 + 5) °C:

— at the controller and sensor (or PID) connection, any short circuit or interruption shall result in a non-permissive signal;

— under or over supply voltage conditions as defined by the manufacturers specification; shall result in non-permissive or correct operation. The test criteria shall be:

  — under voltage: from zero volt to the minimum supply voltage specified by the manufacturer;

  — over voltage: from the maximum supply voltage specified by the manufacturer to 1,5 times this value, or the maximum rated voltage according to EC-Type Examination Certificate, whichever is the smaller.

6.1.4 EMC test

Tests shall be carried out in accordance with:

— EN 61000-6-3 for emission;

— EN 61000-6-1 for immunity;

— ISO 7637-2 (pulse 2a, 2b, 3a, 3b, and 4).

During and after these tests the controller shall work properly or shall switch to "filling not permitted".

6.2 Manufacturers production test

6.2.1 General

Production tests shall be carried out by recording as a minimum the following:

— identification of the product tested;

— the test and inspection results;

— the date of tests;

— the identification of the responsible person for the test.

6.2.2 Controller response

The controller shall be connected to the maximum number of permitted sensors or simulated circuits and when any sensor or combination of sensors is wetted, the response time for the controller to switch from permissive to non-permissive shall be measured and recorded. This response time shall be within the maximum specified 1 s (without reaction time of the sensor).

At the end of the test there shall be no controller failure.

6.2.3 Current interface

To test the controller, a sensor or sensor simulator shall be used.

If a sensor simulator is used it shall consist of a passive current source which shall sink a stabilized current at a varying supply voltage between DC 5 V and DC 20 V and able to withstand a short circuit current of ≥ 114 mA. The current shall be selectable between 0 mA and 60 mA.

a) Connect the controller to the sensor simulator.

b) Power up the system, set sensor simulator at 0 mA.

c) The controller output shall remain stable in the non-permissive state.

d) Setting the sensor simulator to a current value between $I > I_3$ and $I < I_2$ for any duration shall result in a non-permissive signal of the controller.

e) Switch sensor simulator to $I > I_1$ for > 0,5 s.

f) Reducing the current to $I < I_2$ but with $I > I_3$ shall lead to a permissive signal.

g) Setting the current to $I > I_2$ shall result in a non-permissive signal, the time shall be recorded and shall not exceed 1,0 s.

h) Reducing the current to 0 mA, switch to $I > I_1$ and reduce the current to $I < I_2$ within < 0,5 s, this shall result in a non-permissive signal.

i) Disconnect the sensor simulator (open circuit condition), the output of the controller shall stay non-permissive.

j) Short circuit the current interface, the output of the controller shall stay non-permissive.

k) If a sensor is used the sensor characteristic shall be checked and documented.

    1) The current and the permissive signal shall be logged with a storage oscilloscope.

    2) Dipping the sensor in a test liquid shall result in a non-permissive signal within 1 s.

    3) Disconnect the sensor (open circuit condition), the output of the controller shall stay non-permissive.

    4) Connect a resistor with current $I < I_2$ and $I > I_3$ for not less than 0,5 s. The output of the controller shall stay non-permissive.

    5) Short circuit the socket, the output of the controller shall stay non-permissive.

6.3 Binary/Digital interface

6.3.1 General

The results shall be recorded.

6.3.2 Sensor and digital interface

The tests shall be performed according to EN 14116.

6.3.3 PRD

A functional test shall demonstrate that the reaction time from receiving the digital signal change according to EN 14116 (from permissive to non-permissive) to the output of the controller is ≤ 1 s.

7 Marking

In addition to the explosion protection marking:

— EN 16657.

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